BERMUDA ELECTRIC LIGHT COMPANY LIMITED

ANNUAL OPACITY MONITORING REPORT

For the period

January 1st, 2020 to December 31st, 2020

Prepared by:

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Occupational Health, Safety & Environment Business Centre/ iEPC Limited

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(January 1st, 2020 through December 31st, 2020)

Introduction

This report summarizes BELCO's Continuous Opacity Monitoring System for the period **January 1st, 2020 to December 31st, 2020** as required under Conditions 5.3 and 6.3 of BELCO's Operating License (OL-114). The report presents information related to opacity previously reported in 2020 Quarterly Report to the Environmental Authority and includes: summary data collected from the in-stack opacity instruments for diesel engines E7, E8, N1, N2, N3 and N4; availability statistics and maintenance performed on all operating opacity instruments; results for monthly visible emissions (VE); as well as a Non-Compliant Engine (NCE) summary for the year.

In-Stack Opacity Monitor Exceedances

Bermuda Clean Air Regulations 1993 limits emissions to a standard of 20 percent opacity over a six-minute average. BELCO's Operating License OL-114 allows for exceedances of this opacity standard under certain conditions as stated in Section 5.3.2. Opacity emissions are presently measured using in-stack Continuous Opacity Monitoring Systems (COMS) on six (6) of BELCO's diesel engines. In addition to units on E7 and E8, four new COMS were commissioned and handed over to BELCO at the North Power Station on 1 April 2020 for diesel engines N1, N2, N3 and N4. It is also important to highlight the fulltime retirement of EPS diesel engines E1, E2, E3 and E4 and remaining OPS diesel engines D3, D8, D10 and D14 took place during Q4 2020. The engine retirements were made permanent by BELCO Bulk Generation on 30 November 2020.

The COMS utilized in all installations consist of Teledyne Monitor Labs' Lighthawk Model 560 Compliance Opacity Monitors. It is noted that diesel engines E1, E2, E3, E4, E5 and E6 were not fitted with in-stack opacity meters and therefore BELCO's opacity emissions from these diesel engines and those in the Old Power Station (D-engines) were monitored in 2020 using monthly visual opacity observations as per EPA Alternative Method ALT-082.

During the 2020 monitoring period there were four (4) exceedances of the regulatory standard recorded by the in-stack opacity monitors. The first two exceedances took place in Q1 from E8 on February 26th and March 3rd, 2020. The cause of these exceedances was due to engine operations at loads at 50% or below maximum load. The reason for operating the E8 unit at lower loads was to accommodate the North Power Station (NPS) commissioning and run-in period at full load. The last two exceedances occurred in Q4 also from E8 on 26 November for a single 6-minute period beginning at 09:06 and over a prolonged startup during the island blackout restoration on December 18th.

Since 2010, there has been a significant reduction in the number of opacity exceedances reported (see **Figure 1**). Although this was an increase of 3 exceedences over the single occurrence in 2019, opacity exceedance records have decreased by approximately 89% when compared to exceedences

observed in 2010. This continues to demonstrate BELCO's continued effort to improve our Standard Operating Procedures (SOP's) and operate more efficiently. All remaining exceedances recorded by the in-stack opacity monitors presented in the quarterly reports are permitted under Section 5.3.2. of BELCO's Operating License.

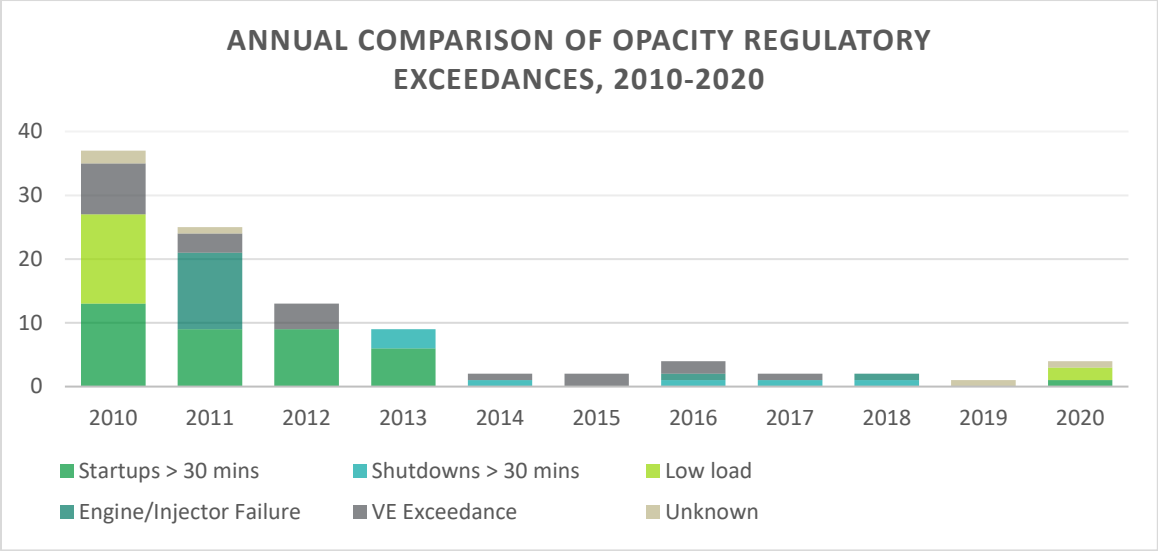

Figure 1: Comparison of Opacity Monitor Regulatory Exceedances 2010-2020

Data Availability

Data availability throughout the reporting period was considered generally high in 2020 for all in-stack opacity units. The 2020 annual cumulative availability for E7 and E8 was 96.35% and 96.57%. As COMS at North Power Station were handed over to BELCO on April 1st, the pro-rated availability for the last three quarters of 2020 was reported to be 97.90%, 90.06%, 97.76% and 81.29% for N1, N2, N3 and N4 respectively (see **Figure 2**).

As such, four out of six COMS met the 95% data availability target for 2020. The lower data availability observed on the N2 (90.06%) and N4 COMS (81.27%) was due to a common fault directly related to the stocking and ultimate replacement of faulty purge air filters experienced during Q3 2020.

Opacity System Calibration and Maintenance

Each COMS instrument is challenged daily and is required to pass a zero (0%) and span calibration (25-28%). Annual calibration drift data showed that, for the six active opacity monitors, 23 daily calibrations of a possible 1,830 total calibration days in 2020 failed. It is noted that Q1 saw a total 3 days of instrument drift above 4% for E7 and E8 (i.e., either a zero, span or both), Q2 saw 7 total days, Q3 had 12 total failure days while Q4 2020 saw a single day of calibration drift above 4%. All reported opacity data that followed a failed calibration was flagged as invalid in CEMLink6 until such time a successful calibration was achieved. In many cases, the COMS instrument self-corrected while

for more serious failures a maintenance visit was required for instruments that did not self-correct. In accordance with BELCO's Operating License #OL-114, DENR was notified of all issues that resulted in significant data loss.

Regular bi-monthly maintenance was scheduled and executed by BELCO Bulk Generation Electrical & Instrumentation personnel on all operating COMS during 2020. In addition, more detailed on-stack maintenance was performed by VIM Technologies personnel in March 2020 on E7 and E8 Lighthawk instruments. This service visit report is attached in **Appendix I**. VIM personnel also assisted in the initial commissioning of the North Power Station COMS on N1, N2, N3 and N4 during the March visit and directly supported the integration of all NPS opacity data into their proprietary SCADA system CEMLInk6. Due to COVID-19 travel restrictions, VIM personnel were unable to return to Bermuda for a second 2020 maintenance trip originally scheduled for Q3 2020. This visit was postponed to 2021 when COVID related travel restrictions become less onerous.

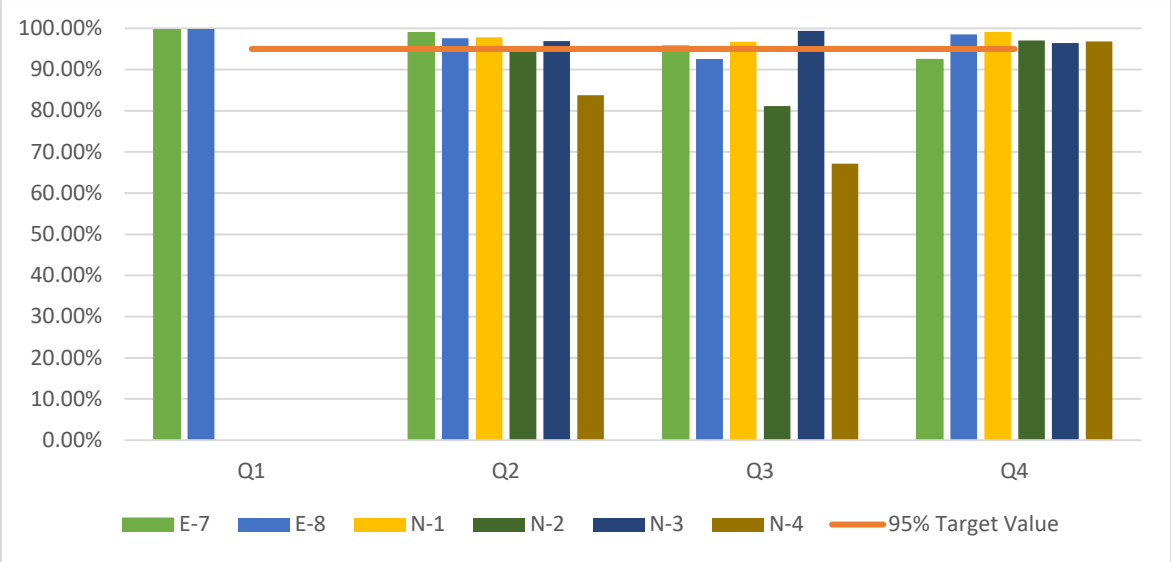

Figure 2: Annual Data Availability of In-Stack Opacity Monitors 2020

Visible Emissions Monitoring

Visible Emissions (VE) monitoring was completed monthly for active engines without dedicated COMS (i.e., D-engines, E1, E2, E3, E4, E5 and E6) throughout 2020 for which there were no reported exceedances of the 20% regulatory standard. Details of all visible emissions monitoring activities can be found in the 2020 quarterly reports previously submitted to the Environmental Authority.

BELCO maintained at least one certified visual opacity reader on staff during 2020 as required under Condition 5.3.4 of BELCO's Operating License #OL-114. All readers were certified by Eastern

Technical Associates (ETA) in the case of U.S.E.P.A. Federal Reference Method 9, and/or Virtual Technology LLC in the case of U.S.E.P.A. Alternative Method 082 and utilizing ASTM D-7520-09 (ALT-082).

During the 2020, period BELCO and iEPC personnel held the following VE certifications:

Method 9: OHSE Coordinator, Date of Certification February 19, 2020; Expiration August 20, 2020

ALT-082:

OHSE Coordinator, Date of Certification September 12, 2018
OHSE Coordinator Refresher Training September 12, 2018
Environmental Engineer, Date of Certification August 18, 2018
OHSE Coordinator, Date of Certification October 4, 2017

It is noted the ALT-082 certification from Virtual Technology LLC is maintained by the submission of a valid observation on a quarterly basis. **Appendix II** contains copies of all Visible Emissions Evaluator and Digital Still Camera Operator Certificates.

Operation of Non-Compliant Engines (NCEs)

The Environmental Authority's approval for NCE operation shall be requested on a case-by-case basis by BELCO as per the Appendix of BELCO's Operating License by the Department of Environment & Natural Resources' Environmental Authority. Although there was a total of 36 minutes of engine E8 operation above the 20% opacity standard during normal engine operation in Q1 2020 and a total of 48 minutes of operation of engine E8 during Q4 2020, no engines assigned were assigned NCE status by BELCO in 2020. Therefore, there was no NCE operation in 2020.

Conclusion

During the 2020 monitoring period there was four (4) exceedances for E8 of the regulatory standard for opacity recorded by the in-stack opacity monitors. Four new COMS were commissioned and handed over to BELCO at the North Power Station on 1 April 2020. There was a total of twenty-three (23) failed daily calibration drift tests for all opacity monitors in 2020. Visible Emissions monitoring was completed monthly throughout the period for which there were no exceedances of the 20% regulatory standard recorded. BELCO maintained a certified VE reader in both EPA Method 9 and/or Alternative Method 082 throughout 2020. Maintenance of the opacity monitoring system was routinely performed bi-monthly by BELCO Instrumentation and Control personnel and VIM personnel performed detailed on-stack calibration for COMS on E7 and E8 in March 2020. There were no engines assigned NCE status in 2020 and therefore no NCE operations in 2020.